

TENNESSEE

Stream Water Quality

Abundant precipitation (about 48 inches annually) provides Tennessee with a large supply of stream water (U.S. Geological Survey, 1986, p. 425-430). Surface-water withdrawals for offstream use in 1985 averaged 8,010 Mgal/d (million gallons per day), or 95 percent of the combined surface- and ground-water withdrawals for offstream use. The major offstream uses of surface water were thermoelectric power generation (6,060 Mgal/d), industrial supply (1,510 Mgal/d), and public supply for domestic, commercial, and industrial use (384 Mgal/d) (U.S. Geological Survey, 1990, p. 469-472). Surface water is the principal source for public supply in central and eastern Tennessee, where ground-water resources are limited.

Most of Tennessee's stream water is suitable for all uses designated by the State (Tennessee Department of Health and Environment, 1990, p. 2). These designated uses are domestic, commercial, and industrial water supply; propagation and maintenance of aquatic life; wildlife maintenance; livestock watering; irrigation; navigation; recreation; and enjoyment of scenic and esthetic qualities (Tennessee Department of Health and Environment, 1987, p. 1). The relative importance assigned to each designated use differs within and among drainage basins.

The suitability of stream water for its designated uses can be affected by land use. Land use in Tennessee (fig. 1A) is determined in part by physiography. Rolling hills and broad flood plains in the Coastal Plain province (fig. 1B) support the greatest concentration of agricultural activity. Thin soils in the Western Valley and Cumberland Plateau are inadequate for farming; therefore, those areas remain predominantly forested. Gently rolling areas within the Valley and Ridge province, Highland Rim, Central Basin, and Sequatchie

Valley support some cropland and pasture in addition to forest. Land in the Blue Ridge province of eastern Tennessee is rugged and densely forested.

The Cumberland, Tennessee, and Mississippi Rivers are the major streams in Tennessee. In the drainage basins of the Cumberland and Tennessee Rivers, reservoirs provide flood control, navigation routes, electric power, and water supplies for growing population centers (fig. 1C) along the rivers. The State's 1990 population was 4.9 million—an increase of 6.2 percent from 1980 (U.S. Bureau of the Census 1990 decennial census files).

WATER-QUALITY MONITORING

Water-quality data obtained from analyses of water samples collected at monitoring stations are stored in the U.S. Geological Survey's (USGS) National Water Information System and the U.S. Environmental Protection Agency's (EPA) national data base known as STORET. Water-quality and streamflow data are reported by water year—the 12 months from October 1 through September 30. A water year is identified by the calendar year in which it ends. For example, water year 1991 comprises October 1, 1990, through September 30, 1991.

The data used in this summary of Tennessee's stream water quality were obtained from water samples collected at 11 monitoring stations at which data collection is systematic and continuing (fig. 2). Analyses of water samples collected at 10 stations are the basis for the discussion and graphic summary (fig. 3) of stream water-quality conditions for water years 1987-89, and data from 8 stations

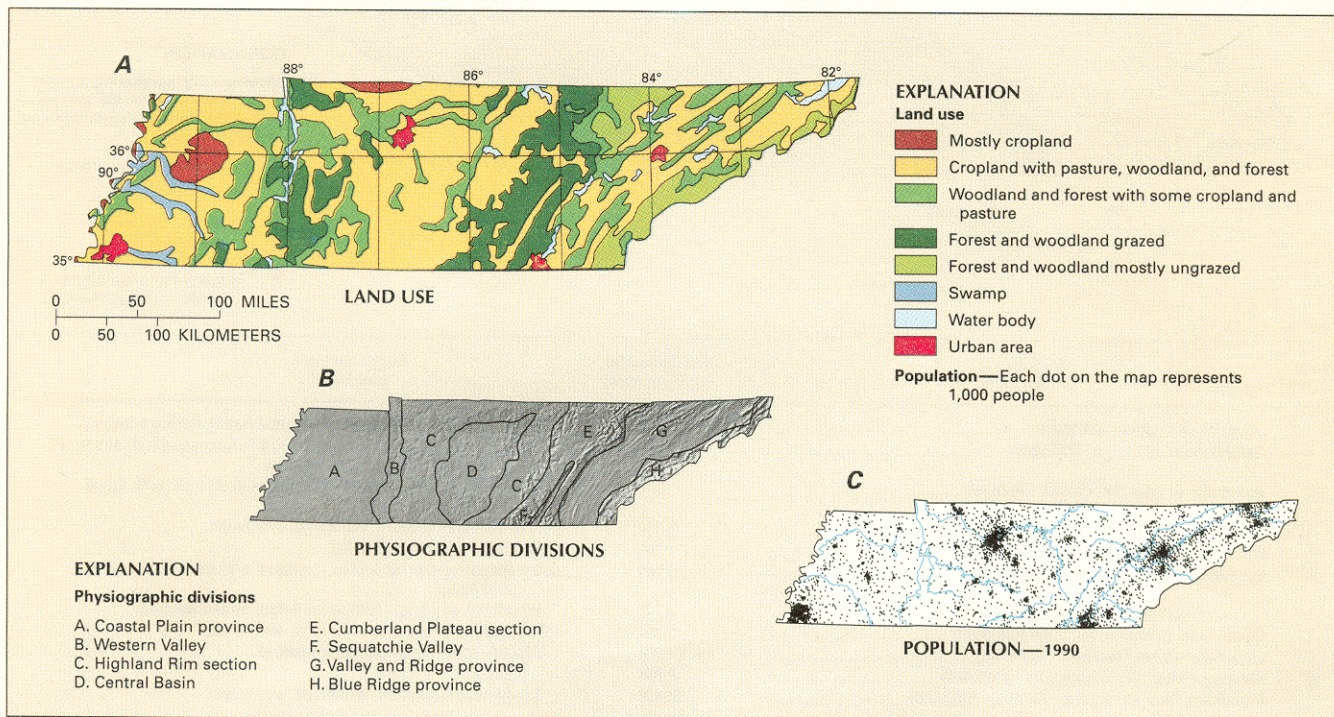


Figure 1. Land use, physiography, and population in Tennessee. A, Major land uses. B, Physiographic divisions. C, Population distribution in 1990. (Sources: A, Major land uses modified from Anderson, 1967. B, Physiographic divisions from Fenneman, 1946, and Miller, 1974; landforms from Thelin and Pike, 1990. C, Data from U.S. Bureau of the Census 1990 decennial census files.)

are the basis for the discussion and graphic summary (fig. 4) of stream water-quality trends. Water samples were collected and analyzed by using standard methods approved by the U.S. Geological Survey (Britton and Greeson, 1987; Fishman and Friedman, 1989; Ward and Harr, 1990) or by using equivalent methods. If a method for sample collection or analysis changed over time, data from an analysis were included in the evaluation of recent stream water quality or of stream water-quality trends only if the change in method did not affect the comparability of the data.

WATER-QUALITY CONDITIONS

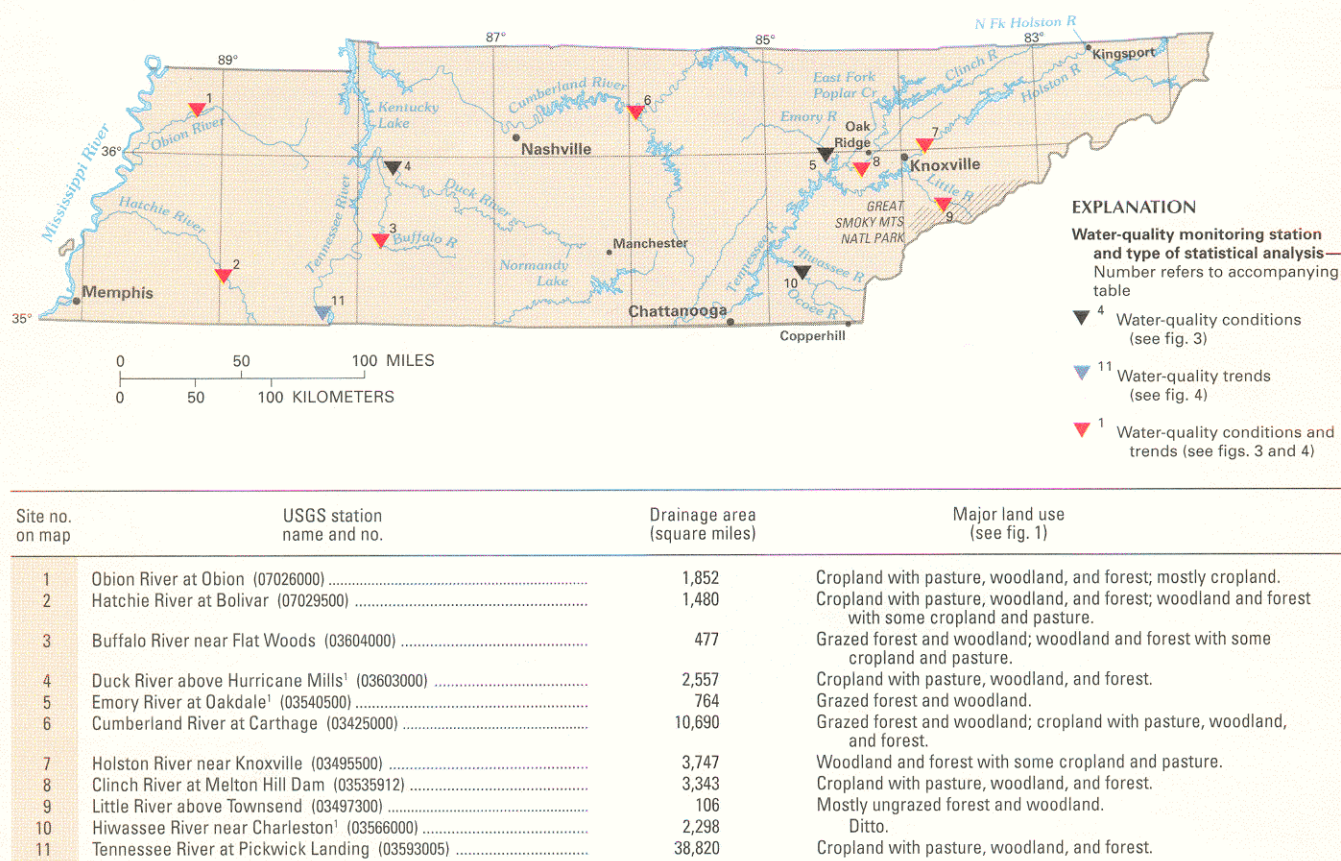
Water years 1985-88 were periods of severe drought in Tennessee, particularly in the eastern part. Precipitation during water years 1987-88 was about 75 percent of normal, and even less during the summers. Streamflow was about 50 percent of normal (U.S. Geological Survey, 1991, p. 511) and, during the summer, was dominated by ground-water discharge. In contrast, precipitation in water year 1989 was about 130 percent of normal. These extremes in precipitation substantially affected the water quality of streams and the many large reservoirs in the State (Neil E. Carriker, Tennessee Valley Authority, written commun., November 1989).

In 1990, water in 51 stream segments contained levels of toxic or other chemicals that exceeded criteria established by the Tennessee Department of Health and Environment (1990, p. 81-84) for the protection of public health. These stream segments, totaling 193 miles or about 1 percent of the 19,000 stream miles in the State, were posted by the Department as unusable or unsafe. Excessive concentrations of fecal coliform bacteria in reaches downstream from municipal

sewage-treatment plants were cited as a common problem. In general, however, the major causes of degraded water quality in the State were nonpoint sources such as agricultural activities, stream channelization, mining, and urban runoff. Contamination from these sources affected more than 3,300 stream miles in 1990 (Tennessee Department of Health and Environment, 1990, p. 10). Die-offs of mussels, as well as tainted flesh, skeletal deformities, and disease in catfish, have prompted several water-quality investigations at Kentucky Lake reservoir (fig. 2). Continuing investigations have identified several potential causes, including low dissolved-oxygen concentrations during drought, siltation, industrial and municipal wastewater discharges, application of aquatic herbicides, and agricultural runoff.

The following discussion of stream water quality in Tennessee is organized by river basin (fig. 3). Where physiographic and land-use characteristics in different basins are similar, the discussion of those basins is combined. Graphs in figure 3 summarize certain aspects of stream water quality in the basins for water years 1987-89. The graphs show frequency distributions of data values that represent concentrations of selected stream-water constituents. These constituents are dissolved oxygen, fecal coliform bacteria, dissolved sulfate, dissolved solids, dissolved nitrite plus nitrate (as nitrogen), dissolved phosphorus (as phosphorus), and suspended sediment. The data are reported in milligrams per liter (mg/L) and colonies per 100 milliliters (col/100 mL). Sources and environmental significance of each constituent are described in table 1.

Water quality at each monitoring station is the result of geological, chemical, biological, and hydrologic processes that occur over a large area. Water-quality problems that affect aquatic life or public health only locally are not fully represented in this summary.



¹ Station operated by Tennessee Valley Authority (1974).

Figure 2. Selected water-quality monitoring stations, type of statistical analysis, and geographic features in Tennessee. (Sources: Major land uses modified from Anderson, 1967; other data from U.S. Geological Survey files.)

OBION AND HATCHIE RIVERS

The drainage basins of the Obion and Hatchie Rivers are in the Coastal Plain province, which is underlain by loess, sand, gravel, and clay. In this area, stream water contains low concentrations of dissolved minerals. However, many streams in western Tennessee carry large sediment loads because soils in the agricultural areas are easily eroded.

Upstream from site 1, streams in the Obion River drainage basin have been extensively channelized to drain wetland areas and to promote agriculture. Agriculture is the dominant land use affecting water quality in the basin. Median (50th-percentile) concentrations of nitrite plus nitrate (0.52 mg/L) and suspended sediment (131 mg/L) were higher for site 1 than for those at any other monitoring station (fig. 3). High concentrations of fecal coliform bacteria are an additional, recurring water-quality concern (Tennessee Department of Health and Environment, 1990, p. 33).

Land use in the Hatchie River drainage basin is similar to that in the nearby Obion River basin, except that the upper part of the basin, which is in Mississippi, is more heavily forested. The lack of channelization and agriculture within the flood plain adjacent to the Hatchie River main stem probably accounts for the lower median

concentrations of nitrite plus nitrate (0.23 mg/L) and suspended sediment (37 mg/L) for site 2 compared to those in the Obion River (Tennessee Department of Health and Environment, 1990, p. 27). However, concentrations of fecal coliform bacteria at site 2 sometimes exceed the criterion of 1,000 col/100 mL for an individual sample that was established by the State (Tennessee Department of Health and Environment, 1987) to protect recreational water use.

BUFFALO RIVER

The Buffalo River drainage basin lies entirely within the Highland Rim. Because the limestone and overlying soils of this section have been extensively weathered, leaving little soluble material behind, streams draining these areas contain low concentrations of dissolved minerals (Tennessee Valley Authority, 1963, p. 7). As a result of the steep slopes and leached soil, land in most of the section remains forested; small cleared areas are used mainly for growing hay and grazing. Thus, water quality in the Buffalo River drainage basin upstream from site 3 has been altered only minimally by human activity. Median concentrations of nitrite plus nitrate (0.16 mg/L) and suspended sediment (7 mg/L) were among the lowest for the 10 monitoring stations (fig. 3). In some areas of the basin, however,

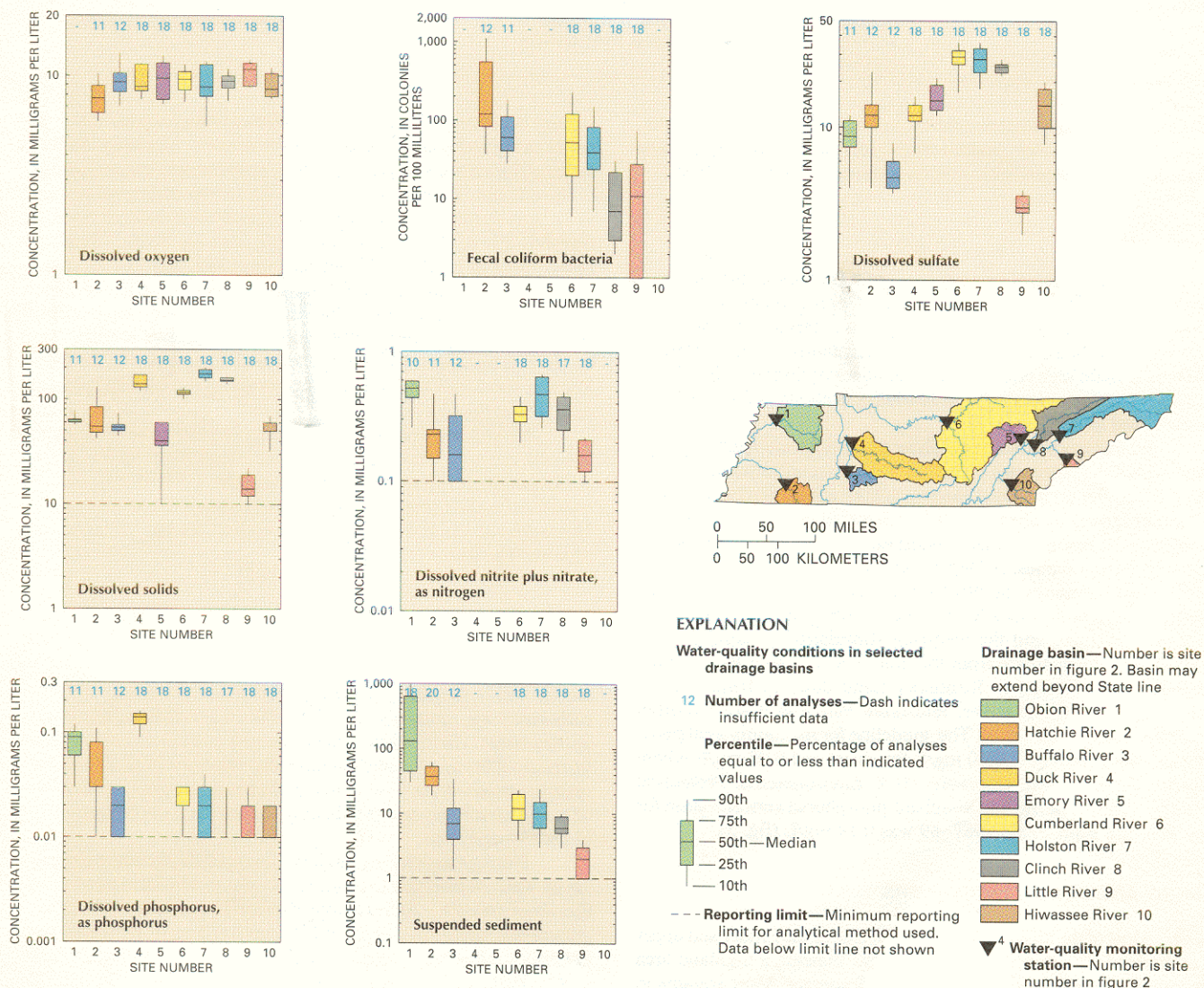


Figure 3. Water quality of selected streams in Tennessee, water years 1987-89. (Source: Data from U.S. Geological Survey and Tennessee Valley Authority files.)

Table 1. Sources and environmental significance of selected water-quality constituents

[Source: Compiled by the U.S. Geological Survey, Office of Water Quality]

Constituent	Common sources	Environmental significance
Dissolved oxygen	Introduced from the atmosphere; also a byproduct of aquatic plants.	Necessary for aquatic life; deficiency can result from assimilation of organic wastes or rapid growth and decay of algae.
Fecal coliform bacteria	Sources include effluent from sewage-treatment plants and runoff from pastures, feedlots, and urban areas.	Presence indicates contamination of water by wastes from humans and other warm-blooded animals.
Sulfate	Occurs in some rocks; also in mine runoff, industrial wastewater discharge, and atmospheric deposition.	Concentrations exceeding a natural, background level indicate contamination from human activity; in sufficient quantity, can cause water to be unsuitable for public supply; can harm aquatic organisms.
Dissolved solids	A result of rock weathering; also in agricultural runoff and industrial discharge.	In sufficient quantity, can cause water to be unsuitable for public supply, agriculture, and industry; can harm aquatic organisms.
Nitrite plus nitrate	Nonpoint sources are agricultural and urban runoff; a major point source is wastewater discharge.	Plant nutrient that, in sufficient quantity, can cause algal blooms and excessive growth of higher aquatic plants in bodies of water; can cause water to be unsuitable for public supply.
Phosphorus	Occurs in some rocks and sediments; also in runoff and seepage from phosphate-rock mines, agricultural and urban runoff, and industrial and municipal wastewater discharge.	Plant nutrient that, in sufficient quantity, can cause algal blooms and excessive growth of higher aquatic plants in bodies of water.
Suspended sediment	A result of rock erosion; also induced by disturbances of land cover due to fires, floods, and human activities such as mining, logging, construction, and agriculture.	Can be detrimental to aquatic organisms; can fill reservoirs and impair recreational use of water.

streams have been contaminated by runoff from highway and allocated land development (Andrew N. Barrass, Tennessee Department of Health and Environment, written commun., November 1989).

DUCK RIVER

The Duck River basin is underlain predominantly by limestone and phosphatic limestone of the Central Basin. Chemical weathering of limestone and overlying soils in this area has not been as extensive as in the Highland Rim; consequently, streams draining this area contain high concentrations of minerals dissolved from rock and soil. Land uses in the basin upstream from site 4 are cropland, pasture, and forest.

Runoff from surface phosphate mines and cultivated soils rich in phosphorus contributes to high phosphorus concentrations in the Duck River. Recurring algal blooms and attendant dissolved-oxygen depletion caused by algal die-off and decay in Normandy Lake reservoir (fig. 2) result from large phosphorus loads in streams of this drainage basin (Tennessee Department of Health and Environment, 1990, p. 44). Perhaps the most serious effect of high phosphorus concentrations in the Duck River is the increased phosphorus loading in Kentucky Lake and the resulting stimulation of algal growth (fig. 2). Just downstream from the mouth of the Duck River, phosphorus concentration in Kentucky Lake doubles from 0.05 to 0.10 mg/L (Neil E. Carriker, Tennessee Valley Authority, written commun., November 1989). The guideline for maximum total phosphorus concentration is 0.10 mg/L for rivers and 0.05 mg/L where streams enter lakes or reservoirs (U.S. Environmental Protection Agency, 1986). The median dissolved-phosphorus concentration for site 4 during water years 1987-89 was 0.14 mg/L (fig. 3).

EMORY AND CUMBERLAND RIVERS

Most of the area of the drainage basins of the Emory and upper Cumberland Rivers is in the Cumberland Plateau, a highland area underlain by sandstone, shale, and conglomerate. Most streams in this area contain low concentrations of dissolved minerals. However, surface and subsurface coal mining and timber harvesting are im-

portant activities in both basins. Surface mining creates spoils that erode easily and contribute sediment to streams. Moreover, minerals leached from these spoils can produce an extremely mineralized and acidic effluent. Timber harvesting can contribute additional sediment to streams through increased erosion, mainly as a result of construction and use of haul roads, skid trails, and log decks (Tennessee Department of Health and Environment, 1989, p. 3.2).

Water quality in the Emory River has been affected by surface coal mining and timber harvesting (Tennessee Department of Health and Environment, 1990, app. A15). Relative to other water bodies that have been affected by these activities, however, the Emory River at site 5 had low sulfate concentrations during 1987-89 (median, 15 mg/L) (fig. 3).

Mining and timber harvesting have degraded the water quality in many creeks within the upper Cumberland River basin (Tennessee Department of Health and Environment, 1990, p. 53). Concentrations of sulfate (median, 29 mg/L) and dissolved solids (median, 116 mg/L) at site 6 were among the highest for the 10 monitoring stations (fig. 3).

HOLSTON AND CLINCH RIVERS

The drainage basins of the Holston and Clinch Rivers are mostly within the Valley and Ridge province, which is underlain by carbonate rock, sandstone, and shale that crop out alternately in long, narrow strips. Dissolution of the limestone and dolomite that underlie much of the area results in high concentrations of dissolved minerals in stream water. Five dams upstream from site 7 regulate flow of the Holston River, and two dams upstream from site 8 regulate flow of the Clinch River.

During the summer, dissolved-oxygen depletion in deep layers of water in reservoirs on the Holston River results in downstream dissolved-oxygen concentrations that are lower than the minimum criteria of 6 mg/L for cold-water fisheries and 5 mg/L for warm-water fisheries (Tennessee Department of Health and Environment, 1990, p. 77). High sulfate concentrations at site 7 (median, 28 mg/L for 1987-89) (fig. 3) result partly from discharges of saline water from natural salt deposits near Saltville, Va., to the North Fork Holston

River. The Holston River contains water having the highest hardness values in the State. Dissolved-solids concentrations at site 7 (median, 175 mg/L) were the highest for the 10 monitoring stations but were lower than the 500 mg/L criterion established by the State (Tennessee Department of Health and Environment, 1987) for untreated drinking water.

The headwaters of the Clinch River drain areas in the Cumberland Plateau in Tennessee and the Valley and Ridge province in Virginia. Runoff from oil and gas drilling and surface coal-mining operations has increased concentrations of sulfate, certain trace elements, and suspended sediment in headwater streams (Tennessee Department of Health and Environment, 1990, p. 68). Sulfate concentrations at site 8 (median, 25 mg/L) were among the highest for the 10 monitoring stations. Suspended-sediment concentrations were low (median, 6.0 mg/L) compared to those in other reaches in the drainage basin primarily because sediment is trapped in the two upstream reservoirs (Trimble and Carey, 1984). The largest urban center in the drainage basin is Oak Ridge, which includes the U.S. Department of Energy Oak Ridge Reservation (fig. 2). Runoff from this area drains to East Fork Poplar Creek then enters the Clinch River downstream from site 8. Water-quality concerns in East Fork Poplar Creek and the Clinch River include increased concentrations of mercury and other metals, organic chemicals, and radionuclides resulting from activities at the Oak Ridge Reservation (Tennessee Department of Health and Environment, 1990, p. 67-68).

LITTLE AND HIWASSEE RIVERS

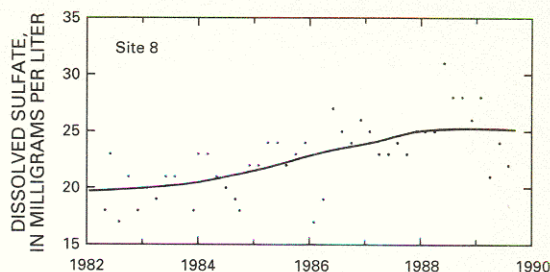
The drainage basins of the Little and Hiwassee Rivers are underlain mostly by crystalline and metasedimentary rocks of the Blue Ridge province. Because these siliceous rocks are relatively insoluble and surface-water drainage is rapid, streams draining this area generally contain relatively low concentrations of dissolved minerals.

Most of the drainage area upstream from site 9, on the Little River, is in the densely forested, uninhabited Great Smoky Mountains National Park (fig. 2). Consequently, water quality at site 9 has not been substantially altered by human activity, as indicated by the low concentrations of sulfate, dissolved solids, nitrite plus nitrate, and suspended sediment (fig. 3).

The headwaters of the Hiwassee River extend into the Blue Ridge province of North Carolina and Georgia; about one-fourth of the drainage basin lies within the Valley and Ridge province in Tennessee. The mineralized waters draining from that province might have contributed to the higher concentrations of sulfate and dissolved solids at site 10 compared to those in the Little River at site 9. Past copper mining and present industrial activities near Copperhill (fig. 2) have degraded water quality in several creeks and three reservoirs on the Ocoee River, the largest tributary to the Hiwassee River. This degradation has resulted in increased acidity and increased concentrations of the trace elements aluminum, cadmium, copper, lead, and zinc and of suspended sediment (Tennessee Department of Health and Environment, 1990, p. 58).

WATER-QUALITY TRENDS

Trend analysis is a statistical procedure used to detect changes in stream water quality at a monitoring station over time. For this report, water-quality data from eight monitoring stations (fig. 2) were analyzed for trends by using the seasonal Kendall test (Hirsch and others, 1982), a method used extensively by the USGS. The graph (shown above right) of the dissolved-sulfate concentration in the Clinch River at site 8 illustrates the trend inferred from the concentration data and demonstrates the variation in water quality that is common in streams.



When possible, constituent-concentration data were adjusted for changes in streamflow to preclude identifying a trend in concentration that was caused only by a trend in streamflow. The data were not adjusted when (1) more than 10 percent of the samples had concentrations lower than the minimum reporting limit for the analytical method used or (2) streamflow was controlled substantially by human activities. When the concentration data could not be adjusted for streamflow, trends were determined directly from the concentration data.

Statewide trends in concentrations of selected stream-water constituents are shown on maps in figure 4. On each map, a trend is indicated at a monitoring station only if the data from that station were suitable for use in the trend analysis. For more information on the suitability criteria and on the trend-analysis procedure used for this report, see Lanfear and Alexander (1990).

DISSOLVED OXYGEN

The dissolved-oxygen concentration in a stream is controlled by several factors, including water temperature, air temperature and pressure, hydraulic characteristics of the stream, photosynthetic or respiratory activity of stream biota, and the quantity of organic material present. A trend in dissolved-oxygen concentrations commonly is directly or indirectly the result of human activities. Generally, an upward trend in dissolved-oxygen concentrations indicates improving stream water-quality conditions and a downward trend indicates deteriorating conditions.

Dissolved-oxygen concentrations had no trend at the seven monitoring stations having data that met the criteria for trend analysis (fig. 4). Trends in dissolved-oxygen concentrations would have been expected only if the quantities of substances that require oxygen for decomposition (for example, human waste) had substantially changed during the trend-analysis period.

FECAL COLIFORM BACTERIA

Fecal coliform bacteria are used as indicators of fecal contamination from humans and other warm-blooded animals. Such contamination can introduce disease-causing viruses and bacteria into a stream.

The cause for the upward trend in fecal coliform bacteria concentrations in the Obion River at site 1 (fig. 4) is not known. Downward trends were expected because the State imposed more stringent controls on the major point source—effluent from sewage-treatment plants—during the 1980-89 trend-analysis period. The monitoring stations, however, might be too distant from sewage-treatment plants to detect the effects of wasteload changes; fecal coliform bacteria do not survive long in the stream environment.

DISSOLVED SULFATE

The major natural sources of sulfate in streams are rock weathering, volcanoes, and biochemical processes (Hem, 1985, p. 113). Human activities such as mining, waste discharge, and fossil-

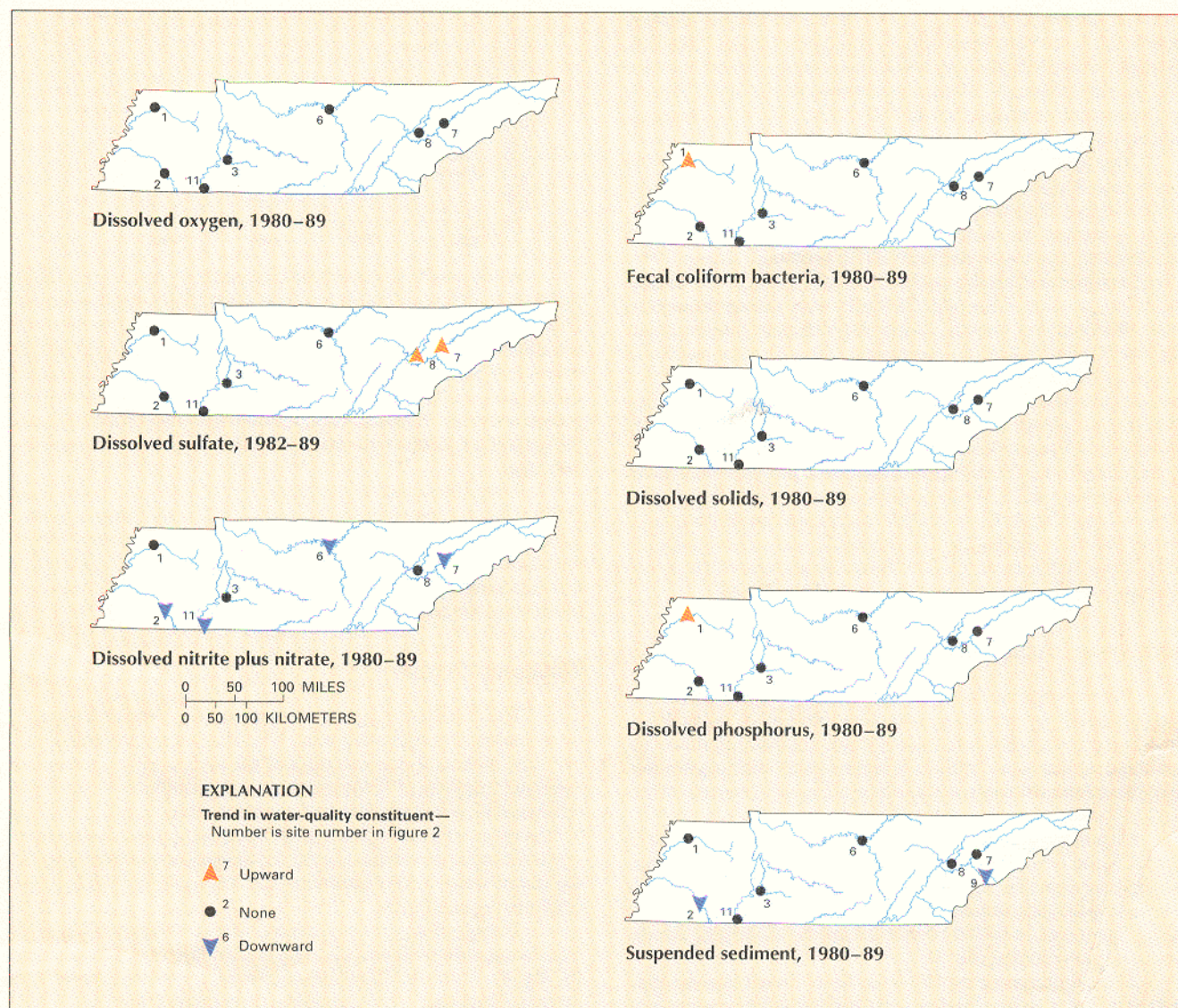


Figure 4. Trends in water quality of selected streams in Tennessee, by water years. (Source: Data from U.S. Geological Survey and Tennessee Valley Authority files.)

fuel combustion also can be important sources. A shortened trend-analysis period was used for sulfate because data obtained before water year 1982 are not comparable to data for subsequent years.

The cause for the upward trends in sulfate concentrations in the Holston River at site 7 and in the Clinch River at site 8 (fig. 4) is not known. Runoff from coal mines is not likely to have caused the trends because coal production decreased during 1982–89 in the drainage basins of the Holston and Clinch Rivers (Linda Johnson, U.S. Department of Labor, written commun., October 1989). Atmospheric deposition of sulfate probably did not cause the trend because atmospheric sources probably contribute too little sulfate to the Holston and Clinch Rivers to cause a detectable trend. Also, the upward trends in those two river basins during 1982–89 did not correspond with known trends in sulfur dioxide emissions (Brand Niemann, U.S. Environmental Protection Agency, oral commun., July 1990), atmospheric concentrations of sulfate (U.S. Environmental Protection Agency, 1989), or sulfate deposition (Schertz and Hirsch, 1985).

DISSOLVED SOLIDS

Dissolved solids in stream water result primarily from rock weathering but also can be introduced as a byproduct of human activities (table 1). Concentrations generally are greatest in streams draining basins underlain by rocks and soils that contain easily dissolved minerals.

Dissolved-solids concentrations had no trend at the seven monitoring stations from which data were suitable for trend analysis (fig. 4). Concentrations of some of the major inorganic components of dissolved solids (sodium, chloride, and potassium) increased slightly in Tennessee streams during this period, presumably because ground-water discharge, which generally has higher concentrations of these components than surface water, represented a large part of streamflow during the statewide drought of 1985–88 (U.S. Geological Survey, 1991, p. 505–512). However, other major components of dissolved solids (calcium, magnesium, and silica) had no change in concentration. The absence of an upward trend at the seven sta-

tions possibly resulted from compensating reductions in loads from nonpoint sources, such as agricultural and urban areas, owing to decreased runoff during the drought.

DISSOLVED NITRITE PLUS NITRATE

Nitrite and nitrate are oxidized forms of nitrogen that together normally constitute most of the dissolved nitrogen in well-aerated streams. Nitrite readily oxidizes to nitrate in natural waters; therefore, nitrate generally is by far the more abundant of the two (Hem, 1985, p. 124).

Some of the observed trends in nitrite plus nitrate concentrations for 1980-89 (fig. 4) correspond to trends in nitrogen-fertilizer use for the same period (Tennessee Valley Authority, 1989). Nitrogen-fertilizer use declined steadily (by about 40 percent) during 1980-89 in the Hatchie River drainage basin, one of the four basins in which nitrite plus nitrate concentration decreased (at site 2). In the three river basins in which concentrations had no trend, fertilizer use likewise had no trends for the 1980-89 period. Improvements in wastewater treatment at several facilities at Kingsport and at Boone Lake reservoir (fig. 2) during 1980-89 might have contributed to the decrease in nitrite plus nitrate concentration in the Holston River at site 7. A cause for the downward trends in the Cumberland River at site 6 and the Tennessee River at site 11 is not readily apparent. The pattern of trends in nitrite plus nitrate concentrations at the seven monitoring stations does not appear to be related to downward trends in atmospheric concentrations of nitrogen oxide observed at locations throughout the State during 1980-89 (U.S. Environmental Protection Agency, 1989).

DISSOLVED PHOSPHORUS

Small quantities of dissolved phosphorus—most of it in the oxidized form, phosphate—commonly are present in streams as a result of rock weathering. Concentrations of dissolved phosphorus in natural water normally are no more than a few tenths of a milligram per liter (Hem, 1985, p. 126) and are usually much lower. Higher concentrations can indicate contamination from human activities (table 1).

Agricultural runoff is a major source of phosphorus in streams; therefore, changes in fertilizer-application rates might be expected to affect stream phosphorus concentration. The trends detected at the seven monitoring stations (fig. 4) correspond closely to trends in phosphorus-fertilizer use in the seven river basins. The increasing phosphorus concentration in the Obion River at site 1 corresponded to a steady increase in fertilizer use in the basin during 1980-89 (Tennessee Valley Authority, 1989). Phosphorus-fertilizer use in the six basins for which no trend in phosphorus concentrations was detected either remained relatively constant throughout the period (as in the Hatchie, Buffalo, and Cumberland Rivers at sites 2, 3, and 6) or fluctuated but had no net change (as in the Holston, Clinch, and Tennessee Rivers at sites 7, 8, and 11).

SUSPENDED SEDIMENT

Suspended sediment is a product of erosion. The erosion can be either natural or the result of land-cover disturbances related to human activities (table 1). Causes for the downward trend in the Hatchie River at site 2 and that in the Little River at site 9 (fig. 4) are not known.

WATER-QUALITY MANAGEMENT

The Tennessee Department of Environment and Conservation, formerly the Tennessee Department of Health and Environment,

Division of Water Pollution Control, administers programs and policies to secure, protect, and preserve the right of citizens to unpolluted waters. The Tennessee Water Quality Control Act of 1977 enables the Division to administer the National Pollutant Discharge Elimination System program and to inspect and regulate wastewater-treatment facilities. The Division performs specific regulatory, enforcement, and monitoring activities. These activities include developing water-quality standards and criteria, issuing permits to wastewater dischargers, reviewing the operation and maintenance of municipal and nonmunicipal waste-treatment facilities, surveying to determine compliance with effluent and water-quality standards, and monitoring of waste discharges and ambient water-quality conditions.

In compliance with section 305(b) of the Federal Clean Water Act, the Division of Water Pollution Control prepares a biennial water-quality assessment report (Tennessee Department of Health and Environment, 1990) submitted to the EPA and the U.S. Congress. The Division also reviews and certifies Federal permits related to hydrologic modifications; issues State permits for nondischarge wastewater systems and for the alteration of the State's waters, such as channel modification; and administers the Tennessee Surface Mining Law and related regulations.

The Division of Water Pollution Control is the lead agency for the development of Tennessee's nonpoint-source water-pollution management plan, which was implemented in 1989 (Tennessee Department of Health and Environment, 1989). The Division participates in interagency work groups and interstate organizations, including the Management Advisory Group of the nonpoint-source water-pollution program, the Kentucky Lake Task Force, the Groundwater Task Force, and the Association of State and Interstate Water Pollution Control Administrators.

The Tennessee Water Quality Control Board, established by the Water Quality Control Act, oversees the State water-management program. The Board is composed of seven members—one designee each from the Departments of Health, Environment and Conservation, and Agriculture and one representative each from industry, municipalities, conservation interests, and the public.

Because of the many reservoirs in Tennessee and their effect on stream water quality, the Tennessee Valley Authority and the U.S. Army Corps of Engineers also have significant water-quality-management responsibilities. Both Federal agencies conduct water-quality monitoring and assessment programs, and both consider stream water quality in their reservoir operations.

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